REMARKS

The Office Action dated September 26, 2007 has been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

Claims 1, 2, 4, 6-8 and 11-19 have been amended to more particularly point out and distinctly claim the subject matter which is the invention. Claims 23-24 have been added. Claims 20-22 have been cancelled without prejudice or disclaimer. No new matter has been added. Claims 1-19 and 23-24 are submitted for consideration.

Claims 1-7, 9, 11-16, 18 and 20-22 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Publication No. 2005/0013347 to Pan (hereinafter Pan) in view of U.S. Patent No. 7,113,540 to Yousef (hereinafter Yousef) and further in view of U.S. Patent Publication No. 2002/0154716 to Erving (hereinafter Erving). According to the Office Action, Pan teaches all of the elements of claim 1-7, 9, 11-16, 18 and 20-22 except for teaching "computing the inverse of a sub-matrix, estimating interference from a received signal at a second observation time, determining additional covariance components on the basis of the estimation and creating the Cholesky decomposition of the inverse matrix of the second covariance matrix by using unitary rotations." Therefore, the Office Action combined the teachings of Pan, Yousef and Erving in an effort to yield all of the elements of claims 1-7, 9, 11-16, 18 and 20-22. The rejection is traversed as being based on references that do not teach or suggest each of the elements of claims 1-7, 9, 11-16, 18 and 20-22, and newly added claims 23-24.

Claim 1, upon which claims 2-10 depend, recites a method including estimating interference from a received signal at a first observation time, creating a first covariance matrix on the basis of the estimation and defining an inverse matrix of the first covariance matrix and a Cholesky decomposition matrix. The method also includes removing selected covariance components from the Cholesky decomposition matrix; and computing the inverse of a sub-matrix, which represents the common part of the first covariance matrix and a second covariance matrix, which includes covariance estimates of a second observation time, by using the aid of the Cholesky decomposition of the inverse matrix of the first covariance matrix. The method further includes estimating interference from a received signal at the second observation time and determining additional covariance components on the basis of the estimation. The method also includes creating the Cholesky decomposition of the inverse matrix of the second covariance matrix by using unitary rotations and generating an output value of the channel equalizer by utilizing information obtained with the aid of the Cholesky decomposition of the inverse matrix of the second covariance matrix.

Claim 11, upon which claims 12-19 depend, recites an apparatus including an estimating unit configured to estimate interference from a received signal at a first observation time, create a first covariance matrix on the basis of the estimation and define an inverse matrix of the first covariance matrix and a Cholesky decomposition matrix. The apparatus also includes a removing unit configured to remove selected covariance components from the Cholesky decomposition matrix and a computing unit configured to

computer the inverse of a sub-matrix, which represents the common part of the first covariance matrix and a second covariance matrix, which includes covariance estimates of a second observation time, by using the aid of the Cholesky decomposition of the inverse matrix of the first covariance matrix. The apparatus further includes an estimating unit configured to estimate interference from a received signal at the second observation time and determine additional covariance components on the basis of the estimation. The apparatus also includes a creating unit configured to create the Cholesky decomposition of the inverse matrix of the second covariance matrix by using unitary rotations and a generating configured to generate an output value of the channel equalizer by utilizing information obtained with the aid of the Cholesky decomposition of the inverse matrix of the second covariance matrix.

As outlined below, a combination of Pan, Yousef and Erving do not teach or suggest each of the elements of the pending claims.

Pan discloses that symbols are to be recovered from signals received in a shared spectrum. Codes of the signals received in the shared spectrum are processed using a block Fourier transform (FT), producing a code block diagonal matrix. A channel response of the received signals is estimated. The channel response is extended and modified to produce a block circulant matrix and a block FT is taken, producing a channel response block diagonal matrix. The code block diagonal matrix is combined with the channel response block diagonal matrix. The received signals are sampled and processed using the combined code block diagonal matrix and the channel response block

diagonal matrix with a Cholesky algorithm. A block inverse FT is performed on a result of the Cholesky algorithm to produce spread symbols. The spread symbols are despread to recover symbols of the received signals. See at least the Abstract.

Yousef discloses that Multi-Input-Multi-Output (MIMO) Optimal Decision Feedback Equalizer (DFE) coefficients are determined from a channel estimate h by casting the MIMO DFE coefficient problem as a standard recursive least squares (RLS) problem and solving the RLS problem. See at least the Abstract.

Erving discloses an algorithm for computing an efficient, reduced complexity, windowed optimal linear time domain equalizer for a dispersive channel includes the steps of determining a window of maximum energy in the impulse response of length equal to or less than a number of cyclic prefix samples associated with a received digital data signal and computing the corresponding inside and outside matrices. The method also inlcudes performing an inverse Cholesky decomposition of the inside matrix, creating a resultant matrix as the product of the outer and the upper and lower square root inner matrix, followed by Householder reduction and QL transformation to thereby compute the time domain equalizer as the linear transformation of the eigenvector corresponding to the smallest eigenvalue at the receiver. The smallest eigenvalue is determined using the aforementioned orthogonal transformations without determining all the eigenvalues efficiently but without the loss accuracy associated with iterative methods like the conventional power method. The algorithm may be most conveniently

implemented, for example, in the form of a thirty-two bit digital signal processor at a data receiver. See at least the Abstract.

Applicants submit that the combination of Pan, Yousef and Erving does not teach or suggest each of the elements recited in the pending claims. Each of independent claims 1, 11, and 23-24 in part, recites removing selected covariance components from the Cholesky decomposition matrix. Pan does not teach or suggest these features.

Figure 2 of Pan is a block diagram of a channel equalizer. A code matrix C is input into the channel equalizer 15. A Cholesky decomposition device 48 produces a Cholesky factor. A block Fourier Transform (FT) 50 takes a block FT of the received vector r. Using the Cholesky factor and the FT of r, forward and backward substitutions are performed by a forward substitution device 52 and backward substitution device 54. See at least page 3, paragraphs 0052-0054 of Pan. As can also be seen from Figure 2 of Pan, the forward substitution is carried out to the combined outputs of the block FT block 50 and the Cholesky decomposition device 48, and the backward substitution is carried out to the combined outputs of the Cholesky decomposition device 48 and the forward substitution device 52. Thus, Applicants submit that it is obvious that these operations of Pan are not equivalent to removing of selected covariance components from the Cholesky decomposition matrix, as recited in claims 1, 11, and 23-24.

Yousef does not cure the deficiencies of Pan. Specifically, Yousef does not teach or suggest removing selected covariance components from the Cholesky decomposition matrix, as recited in claims 1, 11 and 23-24. The Office Action further alleged that that

Yousef discloses an apparatus and method for equalizer where inverse of a submatrix, which represents the common part of the first covariance matrix and a second covariance matrix is computed by using the aid of a Cholesky decomposition of the inverse matrix of the first covariance matrix.

Yousef discloses a method for determining Decision Feedback Equalizer (DFE) coefficients. In Figure 2 of Yousef, with the estimated channel, Feed Forward Equalizer (FFE) coefficients are determined based upon the channel estimate. See step 206 of Figure 2. Then, Feed Back Equalizer (FBE) coefficients are determined based upon the FFE coefficients and the channel estimate. See step 208 of Figure 2. Figure 3 of Yousef describes how FFE coeffcients are generated. First, a DFE delay is selected. See step 302 of Figure 3. Next, the DFE solution is formulated into a least squares solution. See step 304 of Figure 3. This is obtained by minimizing the Mean Square Error. See page 5, line 63-page 6, line 55 of Yousef.

The Office Action referred to equations on page 7, lines 30-35 of Yousef. These equation, that is equations (17) and (18), are a part of the minimization operation. Thus, Yousef does not teach or suggest that an inverse of a submatrix, which represents the common part of the first covariance matrix and a second covariance matrix would be computed nor the use of the aid of a Cholesky decomposition of the inverse matrix of the first covariance matrix, as recited in the pending claims.

Pan discloses data estimation and Yousef discloses computation of equalizer's coefficients. Pan and Yousef are not in the same field of endeavour. Therefore, a person

skilled in the art would not have been motivated to combine the teachings of Pan and Yousef. Nevertheless, even if one skilled in the art were to combine the teachings of Pan and Yousef, the combination would not yield the elements recited in the pending claims as shown in the analysis above.

Erving does not cure the deficiencies of Pan and Yousef. Specifically, Erving does not teach or suggest removing selected covariance components from the Cholesky decomposition matrix, as recited in claims 1, 11 and 23-24. Erving also does not teach or suggest an apparatus and method for equalizer where inverse of a submatrix, which represents the common part of the first covariance matrix and a second covariance matrix is computed by using the aid of a Cholesky decomposition of the inverse matrix of the first covariance matrix, as recited in claims 1, 11 and 23-24.

The Office Action also alleged that Erving discloses estimating interference from a received signal at a second observation time and determining additional covariance components on the basis of estimation. Erving discloses a technique for determining a time domain equalizer suitable for several systems, such as DMT-based DSL modems and OFDM-systems. The proposed algorithm of Erving computes the time domain equalizer at the receiver during a handshake, synchronization, and channel parameter initialization process between the transmitter and a receiver prior to steady-state data communications. The equalizer is applied to the received data to minimize inter-Symbol Interference. See paragraph 0018 of Erving. In paragraph 0058, Erving discloses that it is imperative to design the time domain equalizer (TEQ) with minimal residual and the

utmost accuracy possible. The TEQ is determined only once during initialization and is updated only if channel parameters change over a long period of time. Erving further discloses that the choice of the initial eigenvalue τ and the random vector b determines the convergence of the iterative method and a good initial guess is essential for fast convergence. Thus, Erving is silent about estimating interference from a received signal at a second observation time and determining additional covariance components. Furthermore, if one skilled in the art were to combine the teachings of Pan, Yousef and Erving, the combination would not yield the combination of elements of the pending claims.

Based on the distinctions noted above, Applicants respectfully assert that the rejection under 35 U.S.C. §103(a) should be withdrawn because neither Pan, Yousef nor Erving, whether taken singly or combined, teaches or suggests each feature of claims 1, 11 and 23-24. Applicants submit that because claims 2-10 and 12-19 depend from claims 1 and 11, claims 2-10 and 12-19 are allowable at least for the same reasons as claims 1 and 11, as well as for the additional features recited in claims 2-10 and 12-19.

Claims 8, 10, 17 and 19 were rejected under 35 U.S.C. 103(a) as being unpatentable over Pan in view of Yousef and Erving and further in view of U.S. Patent No. 6,622,1117 to Deligne. According to the Office Action, Pan, Yousef and Erving teach each of the elements of claims 8, 10, 17 and 19 except for teaching "Cholesky factorization of the inverse matrix of the second covariance matrix." Therefore, the Office Action combined the teachings of Pan, Yousef, Erving and Deligne in an effort to yield all of the elements of claims 8, 10, 17

and 19. The rejection is traversed as being based on references that do not teach or suggest each of the elements of claims 1 and 11, upon which claims 8, 10, 17 and 19 depend.

Deligne discloses expectation-maximization equations to iteratively estimate un-mixing filters and source density parameters in the context of Convolutive Independent Component Analysis (CICA) where the sources are modeled with mixtures of Gaussians, a scheme to estimate the length of the un-mixing filters, and two alternative schemes to initialize the algorithm. See at least the Abstract

Deligne does not cure the deficiencies of Pan, Yousef and Erving, as outlined above. Specifically, Deligne does not teach or suggest removing selected covariance components from the Cholesky decomposition matrix, as recited in claims 1 and 11 upon which claims 8, 10 17 and 19 depend. Deligne also does not teach or suggest an apparatus and method for equalizer where inverse of a submatrix, which represents the common part of the first covariance matrix and a second covariance matrix is computed by using the aid of a Cholesky decomposition of the inverse matrix of the first covariance matrix, as recited in claims 1 and 11 upon which claims 8, 10 17 and 19 depend. Deligne also does not teach or suggest estimating interference from a received signal at a second observation time and determining additional covariance components on the basis of estimation, as recited in claims 1 and 11 upon which claims 8, 10 17 and 19 depend.

Based on the distinctions noted above, Applicants respectfully assert that the rejection under 35 U.S.C. §103(a) should be withdrawn because neither Pan, Yousef, Erving nor Deligne, whether taken singly or combined, teaches or suggests each feature

of claims 1 and 11. Applicants submit that because claims 8, 10 17 and 19 depend from claims 1 and 11, claims 8, 10 17 and 19 are allowable at least for the same reasons as claims 1 and 11, as well as for the additional features recited in claims 8, 10 17 and 19.

Furthermore, Applicants respectfully note that the Office Action has pieced together at least three references to teach the claimed invention. However, MPEP 2143.01 instructs that "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. In re Mills, 916 F.2d 680, 16 USPQ 2d 1430 (Fed. Cir. 1990)." MPEP 2143.01 further instructs that "obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art." Applicants respectfully submit that the cited references do not provide such a suggestion or motivation. Applicants submit that the only motivation to piece together the references of the Office Action is found in Applicants' own application. MPEP 2141, under the heading "Basic Consideration Which Apply to Obviousness Rejections," points out that "the references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention." (See also Hodosh v. Block Drug Co., Inc. 786 F.2d 1136, 229 USPQ 182 (Fed. Cir. 1986).) The Federal Circuit has clearly held that "the motivation to combine references cannot come

from the invention itself." Heidelberger Druckmaschinen AG v. Hantscho Commercial Products, Inc., 21 F.3d 1068, 30 USPQ 2d 1377 (Fed. Cir. 1993).

In view of MPEP 2144.03, absent any teaching or suggestion in the prior art to adapt the teachings of Pan, Yousef, Erving and Deligne to meet the claimed invention, and because the rejections lack evidence of a teaching or suggestion that the features would have been obvious to one of ordinary skill, the rejections under 35 U.S.C. §103(a) are improper. Accordingly, Applicants respectfully submit that the rejections under 35 U.S.C. §103(a) should be withdrawn.

As noted previously, claims 1-19 and 23-24 recite subject matter which is neither disclosed nor suggested in the prior art references cited in the Office Action. It is therefore respectfully requested that all of claims 1-19 and 23-24 be allowed, and this application passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

Arlene P. Neal
Registration No. 43,828

Customer No. 32294
SQUIRE, SANDERS & DEMPSEY LLP
14^{TH} Floor
8000 Towers Crescent Drive
Tysons Corner, Virginia 22182-2700
Telephone: 703-720-7800
Fax: 703-720-7802

APN:ksh

Enclosures: Petition for Extension of Time
Check No. 17947